PRIVATE AND CONFIDENTIAL

RESEARCH DEPARTMENT

VISIT TO SWITZERLAND

Report No. A-039

(1956/2)

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

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SUMMARY

This Report describes a visit to Switzerland to attend a Conference of the International Organisation for Standardization, Technical Committee 43 - Acoustics, held in Berne between 7th/9th September 1955. On the outward journey a visit was paid to the Ostend Kursaal which is a modern building containing a concert hall. Since no survey of the acoustic activities of the Swiss PTT has been carried out since June 1949 when Report A-027 was written, the opportunity was taken to visit new studios at Basle. After the Berne Conference a visit was paid to Gravesano to see the experiments being carried out by Dr. Hermann Scherchen, the Swiss conductor, in new experimental studios which he has built. The Lugano studios were also visited. On the return journey from Lugano new studios at Lausanne, Geneva and Paris were visited.

1. BERNE.

1.1. Conference of the International Organisation for Standardization.

The purpose of the Conference of the International Organisation for Standardization, Technical Committee 43 - Acoustics, was to attempt to formulate international standards on "The Normal Threshold of Hearing by Earphone Listening" and on "The Field and Laboratory Measurement of Sound Transmission". The Corporation is not directly interested in the first item but is very much concerned in methods of measuring sound insulation and airborne noise.

The problem of providing adequate sound insulation in studio premises is one of great difficulty, arising from the need to reach a satisfactory compromise between cost of construction and efficiency of insulation. Research is continually in progress in many countries and has resulted in improved constructions, but the inter-change of information is hampered by the lack of agreed methods of measurement. In an endeavour to solve the problem, the Danes and the Germans, in conjunction with the Building Research Station of D.S.I.R., drew up a code of practice which has been used in many European countries for some years.

A tentative specification based on this code of practice was the subject of discussion. While general agreement was obtained, certain sections of the specification caused disagreement and are being referred back to the national committees. As an example of the difficulties encountered, no agreement could be reached on the size of rooms to be used for the laboratory measurement of sound insulation of partitions.

The Germans favour a volume of 80 m^3, while most other delegates consider that 100 m^3 is the minimum desirable because the low-frequency performance of rooms is very dependent on size. The sizes of rooms employed at present are determined largely by those that happen to be available in the various countries and the fact that rebuilding is costly.

In measuring sound insulation, allowance must be made for the sound which does not pass directly through the partition but travels by flanking paths. Several methods of allowing for "flanking transmission" were discussed without agreement being reached.

The outcome of considerable discussion on the presentation of measurements of sound insulation, is a recommendation that the results be given as a graph of insulation in dB plotted against frequency. The use of an average value for all frequencies, although much favoured by architects, was unanimously agreed to be misleading, for sound insulation is usually worst at low-frequencies and an average is therefore deprecated. In view of the various points which could not be settled the Secretariat was given terms of reference on which to attempt to draw up another specification.

Another extremely important matter on which as yet there has been no agreement, national or international, is the measurement of sound absorbing materials and of reverberation time. This has been placed second on the list of documents for international standardization because it is of interest only to organisations and individuals engaged in the acoustic treatment of enclosures, whereas sound insulation is important in many building projects. Nevertheless, there is a large body of interest in this particular subject among broadcasting organisations. The German delegation submitted proposals which could not be discussed for lack of time and because most of the national committees had been unable to consider the draft. The Secretariat has therefore been entrusted with the circulation of a draft for comments on which to base a draft standard.

All these matters are of great importance in the establishment of standards, which are necessary if reliable results are to be obtained in the acoustic design of buildings. Another meeting has therefore been arranged to take place in Paris in February 1957.

1.2. PTT Laboratories - New Sound Measurement Room.

Since the last visit, a new sound measurement room has been constructed which is of great interest to us in view of the need to design such a room for Block C at Kingswood Warren. The method of treatment follows standard practice in that wedges of glasswool are employed. The density of the wedges, however, is greater than we have used in our existing measurement room and as they are also shorter they are much more rigid and do not require support to prevent sagging. Owing to the greater density of the material, the high-frequency absorption is reduced to such an extent as to be inadequate for our purposes. Like a previous room of this type built in Göttingen, the wedges are made dissipative at high radio frequencies to enable acoustic model experiments to be made with radio waves. The necessary conductivity is obtained by the use of milled steelwool, having a mean fibre length of 10 mm and mixed with the glasswool in the proportion 1 kg per m^3. The use of radio frequencies

has also made it necessary to equip the room with a net of stretched nylon cord instead of the usual metal grid. Such a net would be quite inadequate for the heavy loudspeakers and sections of building materials which we intend to test in the new room. Because of the shortness of the wedges, it has been necessary to arrange cavity resonators behind to provide adequate low-frequency absorption.

2. OSTEND - KURSAAL CONCERT HALL.

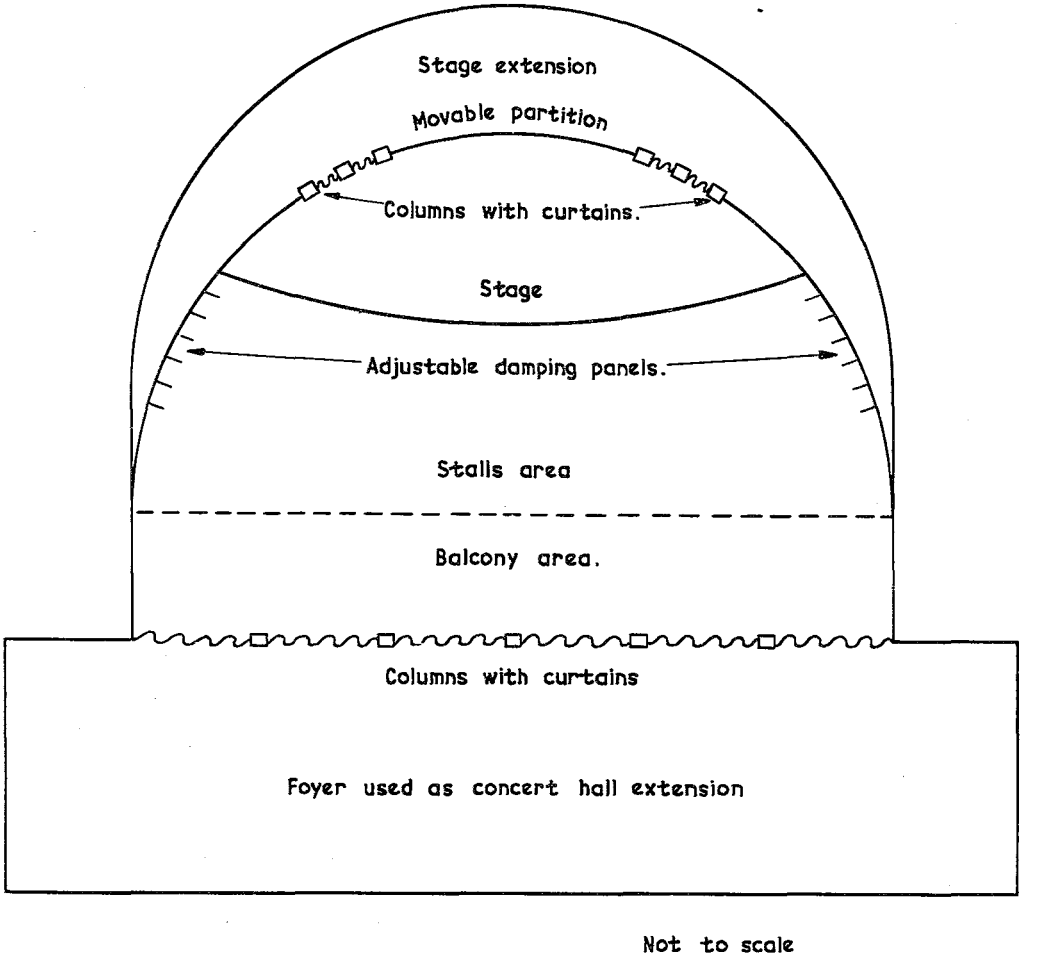

Fig. 1 - Sketch plan of Kursaal, Ostend

The visit to Ostend was made in company with the acoustic consultant, Professor A.C. Raes of l'École National Supériéure d'Architecture, Brussels. This concert hall is unusual in that it is semi-circular in plan as shown in Fig. 1. The seating capacity is fifteen hundred. The semi-circular portion behind the orchestra is panelled, the panels being movable to open up a large stage for dramatic productions. The sides of the stage are also panelled, the panels being reversible to give either reflecting or absorbing surfaces. In fact, they are only used with the hard surface out, but the absorbing material behind has proved to be very useful in damping the cavity. On either side of the stage there are three columns, between which are curtains. It seems that the columns and curtains were originally provided for

aesthetic reasons although they in fact serve a useful purpose in reducing the concentration of sound from the stage area. The ceiling is very slightly curved and quite unrelieved; nevertheless, as it is low in comparison with the other dimensions, the reflections from it follow closely on the original sound and are said not to give trouble. The whole design is such that first reflections from the side walls also follow closely on the original sound and as the sound reaches the audience after very few reflections, the hall is very dead. Perhaps, in view of the shape, this is the best condition. The lack of reverberation is confirmed by measurements and pulse investigations which are based on our methods.

Behind this concert hall there is a rectangular foyer which is normally isolated from the hall by curtains between pillars. It is apparently used when the seating capacity of the hall is not great enough for those wishing to listen to concerts. It is reverberant and is reputed to provide very satisfactory listening conditions, a statement which is difficult to believe. It may be that, compared with the dead sound in the main hall, the reverberation in this foyer may be an advantage. Unfortunately it was not possible to hear an orchestra and the opinions here expressed are based on experience of concert halls lacking in reverberation. Apart from this concert hall there is nothing of interest in the Kursaal. The architecture, however, shows imagination and the general effect is pleasing.

3. BASLE - STUDIOS.

On the way to Berne a visit was paid to the Swiss PTT studios at Basle where extension and reconstruction are in progress.

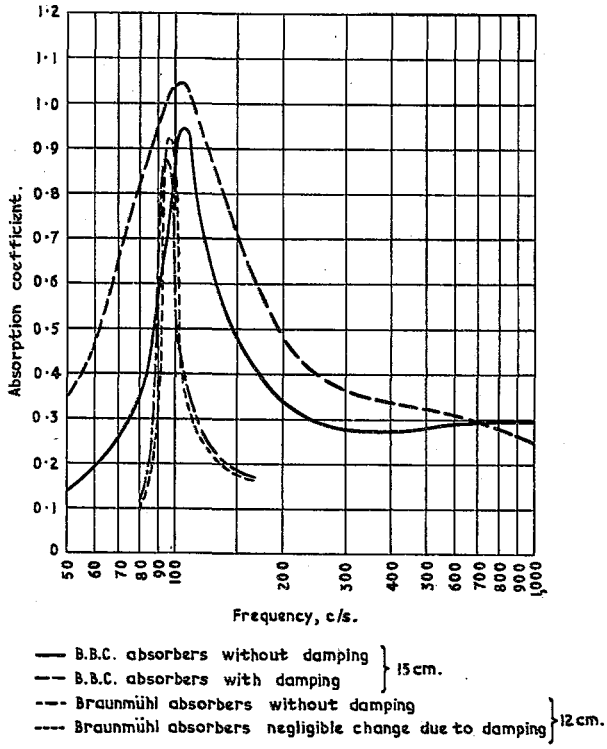

Fig. 2 - Comparison of B.B.C. membrane absorbers and Braunmühl absorbers

A new panel absorber was seen in this Centre and is of a type recently devised by Dr. H.J. von Braunmühl, the Chief Engineer of Südwestfunk at Baden-Baden. It is similar in principle to the membrane absorbers used in the B.B.C. since 1948. The principle difference is that the membrane consists of a building board panel tuned by means of a steel weight fixed with a bolt to its centre. Damping is provided in the box, as in our membrane absorbers, by means of a blanket of glasswool. There is not, however, the advantage of the damping inherent in the bitumen paper roofing material which we employ for the membrane and as the mass and stiffness are greater the resonance is sharper. These absorbers are described in a recent paper by A. Lauber[1]. Fig. 2 shows a comparison of the B.B.C. and Braunmühl absorbers for approximately the same frequency of resonance. It will be seen that the B.B.C. absorber is much more efficient over a wider band of frequencies. The effect of damping by the glasswool

blanket is negligible in the Braunmühl absorber.

One of the existing talks studios has already been re-treated using areas of glasswool for middle and high-frequency absorption and Braunmühl panel absorbers for low-frequency absorption. All the treatment is situated behind wood slats similar to those used in 6C at Broadcasting House and as these slats are removable it is easy to adjust or change the treatment completely without affecting the appearance of the studio. It is also interesting to note that with the adoption of panel absorbers for bass absorption it is not necessary to use cylinders or other devices for diffusion; a fact established by the B.B.C. many years ago. The acoustics of this talks studio are pleasing but the reverberation time is higher than would be tolerated by the Programme Departments in the B.B.C.

In a new studio being built for small orchestras, the walls have been provided with cylinders to obtain diffusion. Most of the absorption, mainly in the low-frequency range, is going on the ceiling in the form of Braunmühl absorbers. It is doubtful whether this is a wise procedure, for experience has shown that absorption should be distributed on all the available surfaces.

A second of the old studios is also being re-treated and eventually the whole Centre will be modernised.

In the other studios in Basle there is nothing of note.

4. LA CHAUX-DE-FONDS - CONCERT HALL.

Professor W. Furrer of the Swiss PTT has acted as acoustic consultant for a new concert hall recently built in this small town to the north-west of Berne, near the French frontier. Professor Furrer was anxious to have an opinion about this hall and a visit was paid with the architect. The hall follows traditional Leipzig lines in that it is rectangular, has a flat ceiling and side and back balconies. It is interesting to note that, although Professor Furrer has often used cylinders in studios, diffusion is obtained in the hall by means of a coffered ceiling. The walls are entirely wood panelled but steps have been taken to ensure that components of the panelling resonate at different frequencies. An orchestra was not heard in this hall but it was noticed that the decay of sound is smooth, the reverberation characteristic is level at about 1·6 sec and no obvious faults such as echoes or colourations could be heard. The hall seats a thousand people and is believed to give every satisfaction.

5. GRAVESANO - SCHERCHEN EXPERIMENTAL STUDIOS.

At Gravesano near Lugano Dr. Hermann Scherchen, the Swiss conductor, has built two experimental studios. Both of these are five-sided. One has been treated to be very dead and the other so far has been left entirely untreated to act as a reverberation chamber. In addition he is constructing a small listening room.

This visit was interesting because of Scherchen's intention to experiment with the recording of music with the minimum number of instrumentalists. His main theme is that it is impossible to get a large number of performers, for example

violinists, all to play in a uniform manner and with a high standard of performance. He believes that by employing only the best performers and restricting the number to one instrument for each part, he can obtain a satisfactory result. In view of the small number of performers, he intends to use an unorthodox internal arrangement of the orchestra together with multi-microphone techniques and the use of artificial reverberation and frequency correction to obtain the desired result. He hopes by these methods to make better recordings of classical music at much reduced cost. When asked if he intended to compose special music he said that his main interest was in the proper recording of classical music. He has been visited by many people interested in recording, music and acoustics and has recently held a conference which was attended by many foreign guests, including the Head of Light Music Programmes, Mr. F.O. Wade, and Dr. Alexander. It is not possible to assess the validity of his proposals because so far he has recorded nothing in the way he has outlined. The unorthodox methods which he intends to use will undoubtedly produce many difficulties. It therefore remains to be seen whether a man of his mercurial temperament will have the tenacity of purpose to overcome them.

6. LUGANO - STUDIOS.

The studios in Lugano are very old and, therefore, not of interest. A new studio centre is being designed on very modern lines but is still in the rather early stages. The most notable feature of the design from the acoustic point of view is the care taken to make the studios of very irregular shapes. This is not a requirement insisted upon by Professor Furrer and his assistants but appears to be a whim of the local architect. Complicated groups of drama studios are being included, a feature which is still the vogue in Switzerland although it has long been abandoned by the B.B.C.

7. LAUSANNE - STUDIOS.

New premises have been built at Lausanne as an extension of the old studio building. In carrying out the acoustic treatment the architect has made considerable use of wood slats behind which are hidden porous absorbers and panel resonator absorbers of the type first seen in Basle. By this means he has been able to obtain the wall contour which he desired without interfering with the acoustic effects of the irregularities. There is extensive use of perforated panelling on ceilings and in some studios cylinders are employed to increase diffusion. Although cylinders are still used in modern Swiss studios, the fashion for them is on the wane. To some extent this is due to the fact that the new panel absorbers are best made rectangular, a shape which is in any case more efficient as a diffuser. The largest of the new studios is intended for variety, although according to B.B.C. standards it would be more suitable for light orchestral combinations. The reverberation time is 1·2 sec in a volume of 1100 m^3 (39 000 ft) which is high by B.B.C. standards and would lead to difficulties in the segregation of instrumentalists and vocalists in variety programmes in this country, even with directional microphones.

The studios for drama are grouped round a common control cubicle as is the standard practice in Switzerland. In every case they were too live by our standards. This remark also applies to talks studios in which it is unusual to find even carpets. In most studios absorption of high-frequencies is lacking, resulting in excessive

sibilance. Throughout this Centre bass absorption is inadequate and electrical correction is therefore used in the microphone circuits to counteract high reverberation time at low-frequencies. The Swiss do not appear to be aware of the disadvantages of such a proceeding, which can only reduce the electrical output from the studio at low-frequencies, while doing nothing to reduce the acoustic effects such as colourations caused by lack of damping.

The older studios in these premises have not yet been re-treated, although it is the intention of the organisation to do so at an early date. The architecture of the new extension is in the modern idiom, carried out with restraint so that the result is pleasing.

8. GENEVA.

8.1. Studios.

A new extension has been added to the studios at Geneva. The comments on the acoustic performance are similar to those for Lausanne, which is to be expected because the acoustic specification and the methods of obtaining absorption are similar. The architectural treatment, however, is very different. To hide the ceiling treatment, a grid of timber, spaced about 50 cm between centres, is constructed about 1 m below the ceiling. Everything above this grid is painted black and as it carries the lighting fittings it becomes virtually impossible to see the treatment above. The disadvantage of this method of concealing the ceiling treatment is that it reduces the visible height of the studios. In contrast with the ceilings, little attempt has been made to cover the treatment on the walls and in the main the result is unsightly.

8.2. Battelle Memorial Institute.

This Institute is of interest because it is run under a bequest, the intention being to provide facilities for research which are available to any organisation either public or private on the payment of the necessary fees. The objects of the Institute are well described in a brochure as follows:

> "Battelle Institute was founded by the will of Gordon Battelle as a memorial to the Battelle family. The Battelles were among the first settlers of Ohio and were prominent in the development of the state's iron and steel industry. Gordon Battelle, last of the family line, impressed with the benefits to be derived from industrial research, left his estate for the building and endowment of an Institute for the purpose of education ... the encouragement of research ... and the making of discoveries and inventions for industry. Operations began in 1929.
>
> As established, Battelle provides, on a not-for-profit basis, the physical plant, equipment and personnel for conducting research. Industrial concerns, groups of companies, individuals, or government agencies contract with the Institute for its research services. They are known as "sponsors". All results from the research become the exclusive property of the sponsor; he is billed for the cost of the work, plus a proportionate share of undistributed expense. In effect, then, Battelle is the "private" laboratory of each of its individual sponsors."

The parent Institute is situated in Columbus, Ohio, and after the War another Institute was established in Frankfurt. It was felt, however, that the Institute in Frankfurt, because of its situation in Germany, would not be made use of by other countries in Europe although it is extensively used by German industry and, therefore, a third Institute was established in Switzerland as being the most centrally placed neutral country. The work of the Geneva Institute is concerned mainly with metallurgical and biochemical problems. At present there is little activity in the field of electrical engineering. Work is undertaken for any organisation provided that there are competent staff available in the Institute. If some major project has to be undertaken and no staff are available it will only be commenced if the necessary competent staff can be obtained. The work is conducted entirely confidentially and the results are the property of the organisation which has paid for the research, although frequently joint technical papers are published. If research work of a similar type has already been undertaken for another client the prospective client is informed and the Institute will reject his application.

There are one or two important points in the physical layout of the premises. The main premises are in a new building which is built on modern lines having three floors and a basement. Offices and laboratories are arranged on either side of central corridors with stairways at each end. Goods and passenger lifts are provided. It is interesting to note that there are no movable partitions and the reason given for this is that in no research laboratory is complete re-arrangement of the accommodation necessary at very frequent intervals. It is, therefore, not economic to incur the high capital cost for the facility of re-arranging all the laboratories when, in fact, only minor changes take place at infrequent intervals. In addition, the sound insulation of movable partitions is extremely poor and, therefore, not suitable for laboratories where the work is concerned with acoustics or any other part of the field of radio where the staff must listen to the results of their researches. The method of construction adopted is to have permanent walls between the corridors and the office and laboratory accommodation. The laboratory space is divided by breeze block partitions which are easily removed when occasional modifications are necessary. This matter was subsequently discussed with Dr. R.K. Cook of the Acoustics Laboratory at the National Bureau of Standards in Washington who is in agreement that for research purposes, where projects last for a number of years, movable partitions are an uneconomic proposition.

Another interesting point about the Battelle Memorial Institute is that an old house on the site has been converted into an administrative block and contains a library having one librarian, one assistant and one secretary. This is done because they wish to avoid the waste of time of having to go to Geneva, which is only a few miles distant, to consult technical publications in libraries. The total staff is 150 and the importance attached to good library facilities is therefore significant.

In the experience of the Battelle Memorial Institute the size of the laboratory block built at Geneva is the most convenient for research purposes. Further development will take place by the construction of other blocks as necessary on the site.

This laboratory is under the direction of Dr. H. Thiemann who previously was engaged on electronic research at the Technical University of Zürich.

9. PARIS.

9.1. Studios.

The main purpose for visiting Paris on the way back from Switzerland was to make contact again with Radiodiffusion-Télévision Française because new studio construction is planned. Furthermore, information was sought on certain problems of sound insulation on which the French have had some experience.

I In the first place a visit was paid to the Centre Pierre Bourdan. In the main the acoustic treatment in this Centre is orthodox. The French believe wholeheartedly in the distribution of the absorbing surfaces and have placed rectangular panels with various types of absorbers in a random arrangement all over the walls and ceilings of the studios. Most of these studios are good, although in talks and drama the reverberation times are sometimes 50% greater than is customary in this country. Because of the greater reverberation time, colourations can be heard but it appears that French producers are not so allergic to colourations as their colleagues in Britain and they appear to be prepared to accept some colourations to obtain more reverberant acoustics.

In this Centre there are two studios which have been much photographed and have given rise to considerable comment. An old library was converted for drama and the architect introduced plaster casts in spherical and cylindrical shapes in addition to the normal acoustic treatment. Spheres are also used in the echo room attached to another drama studio. In the converted library, which is intended for drama, there is not even a carpet on the floor and the reverberation time is so high that there must be difficulty in the segregation of the artists. The studio is sometimes used for light music, for which purpose it would probably be satisfactory. It was interesting to note that for drama in this Centre the French are now placing the whole cast in one studio provided with live and dead ends, a procedure which was adopted by the B.B.C. many years ago.

During discussions on sound insulation it was discovered that the French have employed in this Centre methods which are comparable with those which we are now introducing in the new Bush House studios. Apparently the insulation is just satisfactory, giving 57 dB between studios above each other. We had hoped by similar means to obtain 60 dB at Bush House. The method consists of floating floors and walls on glass-silk blankets and using substantial wall construction with isolation of the studio walls from the outer walls. Considerable supervision was necessary to prevent the builders from bridging the insulation with such things as central heating, conduits for wiring and ventilation trunking. This agrees with B.B.C. experience.

Work has started on a new sound broadcasting centre which is to have a circular plan somewhat reminiscent of the B.B.C. Television Centre. The principal difference as regards the studios is that many of them are being made wedge shaped because of the ground plan of the building, whereas in the Television Centre the studios have been kept rectangular and the other accommodation made wedge shaped. Dr. R. Lamoral, who is now responsible for the acoustic design of studios, appears to be very conscious of the results obtained from fan shapes and the use of reflectors in large studios. He is, therefore, taking steps in the design to avoid such effects. It is interesting that he has checked the results of our experiments on diffusion and having confirmed them is now intending to use rectangular surfaces. He uses the

model technique for checking echoes in all large studios before finalizing the design.

There was some discussion on the use of membrane absorbers for low-frequencies. The French have been using a membrane consisting of a plastic sheet, having the trade name "Klegecel", stretched over a framework and backed by a glass-silk blanket. The disadvantage of this material, however, is the cost. Many years ago when the membrane absorber was developed, various materials were tried including many of the plastic materials, all of which were so expensive as to preclude their use on a large scale, so that we adopted roofing felt as the best compromise between efficiency and cost.

9.2. Programme Meters.

It is well known that for many years the broadcasting organisations throughout Europe have been using peak programme meters which all have similar characteristics although there have been minor differences in construction. Most of the Continental instruments are based on the Siemens programme meter. It appears that the French are now favouring the "VU" meter, mainly, it seems, on the grounds of cost, apparently not realising the operational difficulties which accompany the introduction of this instrument. Because the meter does not read the crest value of the programme waveform a fixed factor of safety has to be introduced. If this factor is made large the general level of the controlled programme is unnecessarily low; if small, frequent overmodulation occurs. Unfortunately, the factor varies with the nature of the programme, so that although some kind of compromise can be achieved by the use of a limiter, inartistic compression effects have then to be tolerated.

10. LOUDSPEAKERS IN GERMANY.

During the Conference in Berne discussion took place with Dr. L. Cremer on a number of subjects, the most interesting being the developments in loudspeakers in Germany. This arose from discussion on a recent paper by Dr. W. Kuhl[2] giving the results of a statistical survey of the preferred reverberation times in concert halls and large studios. The investigation was carried out by making recordings in many concert halls and studios and replaying these recordings to a large number of subjects. Some of his conclusions are in disagreement with B.B.C. results and it was in trying to explain the difference that the question of monitoring and balancing orchestras arose. It seems that the Germans took no special precautions in making the recordings, for apparently they merely recorded normal programme material. This means that many types of microphones and loudspeakers were used and they do not appear to have taken the elementary precaution of using the same loudspeaker for all the subjective tests.

After the B.B.C. methods had been explained and it had been emphasized that great care is necessary in preparing recordings for subjective tests, the discussion turned on the selection by subjective means of loudspeakers for monitoring purposes. During this discussion it transpired that in Germany when tests are done on different types of programme material using different types of loudspeakers, it is usually found that the N.W.D.R. spherical loudspeaker is preferred for music, another type for light music programmes and yet a different loudspeaker for speech. This, of course, is a most unsatisfactory state of affairs and was the difficulty which was resolved by the B.B.C. ten years ago at the time the LSU/10 was selected for monitoring purposes.

11. REFERENCES.

1. A. Lauber. "Plattenresonatoren als akustische Tiefton-Absorber". Technische Mitteilungen PTT, May 1955.

2. W. Kuhl. "Über Versuche zur Ermittlung der günstigsten Nachhallzeit grosser Musikstudios." Acustica, No. 4, 1954, Beiheft 2.

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